A GUIDE TO SELECTION

OF

COMPUTER HARDWARE AND SOFTWARE

FOR

EDUCATIONAL APPLICATIONS

A Joint Project of Saskatchewan Education

and

Saskatchewan School Trustees Association

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Note: The opinions expressed in this report are those of the author and may or may not be in agreement with SSTA officers or trustees, but are offered as being worthy of consideration by those responsible for making decisions.

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PURPOSE

The intents of this document are to aid School Board members and personnel to become more comfortable in their understanding of computers and to suggest some guidelines which could be followed in purchasing computers for Computer Literacy and Computer Science Courses.

The paper consists of a short presentation dealing with two aspects of computers. In the first part of the paper, some general guidelines for selection of computers are developed. No attempt is made to provide direction to a particular model of machine.

The second portion of this paper provides an introduction to the major components of a computer system. These are the components which are most likely to be discussed by schools making requests or salesmen making presentations. For the absolute novice, part two should provide an introduction to those major components, and as such may be worthy of reading prior to the discussion on hardware requirements.

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INTRODUCTION

With the introduction of the microcomputer, courses in Computer Literacy and Computer Science have become a possibility for all schools. This possibility raises questions for teachers, administrators and trustees pertaining to the selection of hardware and the amount of hardware required to implement the program as identified in the Saskatchewan Education Curriculum Guides.

Over the past years many articles have been published which provide interested readers with guidance and direction in addressing the matter of hardware selection. The literature consistently suggests that before one procedes with computer selection, the purpose(s) for which the computer is to be used must be identified. Teaching about computers (Computer Literacy or Computer Science) is different from teaching with computers (Computer Assisted Learning) and in many cases different kinds of computer hardware will be required.

In general, the broader the range of expected activities the computer is to serve, the more difficult the selection. Where computer applications (CAL activities, administrative programs) are most important, software selection followed by the determination of system requirements (ie. what hardware components are required by the software or application program) should precede hardware selection considerations. It is in the area of computer applications where expandability and compatibility should be regarded as important issues. These are not issues of the same magnitude where selection of computers is to be made solely for the purpose of Computer Science and/or

Computer Literacy.

HARDWARE REQUIREMENTS FOR COMPUTER ASSISTED LEARNING

The introduction of CAL activities represents the implementation of computer applications. The key to selecting a computer in these cases will be the applications programs themselves. Usually, these will be programs which will be used by the student. In some cases, they will only be available on specific computer hardware.

The selection of CAL programs should be determined on the basis of their support of the local school instructional objectives and program, not the existance of a particular model of computer. Those responsible for selection of hardware and software must determine if the educational program is to be determined by the software and hardware, or vice versa. A more satisfying instructional experience can be expected if the program or software is selected independently of computer hardware considerations.

Depending upon the level of sophistication of the software, a computer selected for these applications will likely exceed the requirements for computers to be used in a Computer Literacy Program and will often exceed the requirements for computers to be used in a Computer Science Program.

Following the identification of appropriate software or programs, hardware selection can procede. This should involve the identification of system requirements relating to memory size, screen size, auxiliary storage requirements and other particular requirements identified by the documentation as being

necessary for the successful implementation of the program. As the use of the hard ware expands, the demands upon its resources will most likely come to exceed the capacity originally provided. With this in mind, hardware selection should also attend to questions of hardware expandability and portability.

HARDWARE REQUIREMENTS FOR ADMINISTRATIVE APPLICATIONS

For purposes of this document, administrative applications may be considered those which do not occur in the classroom environment. Examples of these would be grade reporting, scheduling, attendance, library and inventory control. Computer systems selected for administrative applications should be ones which allow for a great deal of flexibility. Flexibility would be exemplified by some of the following characteristics:

- memory capacity of 64K or more
- screen size of 80 X 24
- disk storage capacity of 500K bytes or more
- ability to support more than one operating system
- availability of a variety of programming languages
- printer with capability of printing 132 character lines
- printer capable of accommodating varying page sizes
- capability of communicating with other makes and types of computers

Hardware should be selected after appropriate software has been identified and evaluated in terms of local needs. Local school policy should not be determined by restrictions imposed through a computer system developed to meet the needs of another school.

The costs for computers to serve in this area would most likely range between $3000-$4000 for smaller schools and between $5000-$15000 for larger schools. These computers need not be the same type of computer as used for classroom applications.

However, standardization of hardware and software for administrative services throughout a division provide local backup facilities in the event of a system failure.

Where administrative applications are being considered, and in particular applications which may be intended to communicate with facilities at either Saskatchewan Education or the SSTA, schools should contact the computing branches of those agencies to ensure system compatibility.

HARDWARE REQUIREMENTS FOR COMPUTER LITERACY AND COMPUTER SCIENCE

A review of personal computers priced from $400 suggests that almost all of them could be used for teaching Computer Literacy. More care however, must be taken in selecting computers to be used in Computer Science courses.

1. MINIMUM HARDWARE FOR COMPUTER LITERACY

Examination of the program set out in the Interim Guide for Computer Literacy would suggest that it could be taught with a computer consisting of:

- 4K RAM [1]
- a keyboard
- a TV or monitor
- a cassette recorder

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[1] RAM refers to Random Access Memory. RAM is memory in which the user can store programs and variables. 4K of RAM will store 4096 characters.

This particular configuration or arrangement of computer hardware should be considered as bare minimum. Where numbers of students warrant the provision of more than two computers, a reasonable trade-off would be to provide a printer in lieu of one of the computers. This will reduce the total number of computers required because it allows users to develop changes in their programs away from the keyboard thereby freeing the computer for use by others. It is an important addition for the teacher as well in that assignments can be printed by the computer and submitted for grading.

2. APPROPRIATE COMPUTERS FOR COMPUTER SCIENCE 10, 20 AND 30

In order to meet the programming expectations of the curriculum guides in these grades, a more sophisticated computer would be required. For these courses the following equipment should be available:

- a computer with 48K RAM
- a keyboard
- a TV screen or monitor
- a floppy disk drive
- a printer

Where the computers cannot be linked in a network,[2] a floppy disk drive should be attached to each computer.

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[2] A network, as used here simply refers to a method which allows more than one computer to share disk drive and printer resources.

3. HOW MANY COMPUTERS?

In order to allow the students to complete the assigned problems within the class periods used for the course, experience has shown that six (6) hours of keyboard time should be allowed for each student in Computer Literacy. The total keyboard time required for 20 students enrolled in Computer Literacy then would be 20 X 6 hours, or a total of 120 hours.

For students enrolled in Computer Science courses, experience has shown that seventy (70) hours of computer time should be allowed for each student. In this case, where twenty (20) students are enrolled, the time requirement would be 20 X 70 hours, or a total of 1400 hours.

This number does not mean that every student is expected to spend those hours sitting in front of a keyboard. It is merely a 'rule of thumb' number to aid in determining the total number of keyboards required to implement a program.

At best, the computer can only be scheduled for one thousand (1000) hours in a school year. This amount of time may not be available in larger schools where scheduling students and classrooms becomes more difficult. With this consideration in mind, the total compute needs of the school can be determined by totalling the number of hours of compute time required over all computer courses, and determining the number of machines required.

There are at least three approaches which could be considered if only Computer Literacy is to be implemented. One possibility would be to provide, as suggested in the

Computer Literacy/Computer Science Tentative Outline, one 48K computer with disk drive and printer.

A second approach would be to provide three minimum computers in place of each 48K computer recommended above. This has the advantage of providing a higher ratio of keyboards to students, which is desireable in Computer Literacy. The disadvantage would be that less computing power would be available.

A third approach would be to install one computer to stay in the school, and a number of minimum computers which could be rotated within the division for purposes of Computer Literacy.

4. SAMPLE APPLICATIONS OF THE PROCEDURE.

Sample #1

If we were to consider a school, Kindergarten to grade 12 with 350 students, we might expect to find an average of 30 students per grade. The total number of hours of compute time required for a program in both Division III and IV would be calculated as follows:

CL grade 9	30 students X 6 hours =	180 hours
CS grade 10	30 students X 70 hours =	2100 hours
CS grade 11	20 students X 70 hours =	1400 hours
CS grade 12	15 students X 70 hours =	1050 hours
Total computing hours required		4730 hours

Minimum machine requirements:

4730 hours / 1000 = 5 computers with disk access and printer available.

Sample #2

Consider a Division III-IV school consisting of 360 students. The plan is to implement Computer Literacy into grades 9 and 10 in the first year, and Computer Science 10, 20 and 30 over each of the next 3 years.

Year 1

CL grade 9	60 students X 6 hours =	360 hours
CL grade 10	60 students X 6 hours =	360 hours

Minimum machine requirements:

720 hours / 1000= 1 computer with disk access and printer available, or one of the other options identified on the previous page.

Year 2

CL grade 9	60 students X 6 hours =	360 hours
CS grade 10	60 students X 70 hours =	4200 hours
CS grade 10(to gr. 11)	10 students X 70 hours =	700 hours
Total computing hours required		5260 hours

Minimum machine requirements

5260 hours / 1000= 5 computers with disk access and printer available.

Year 3

CL grade 9	60 students X 6 hours =	360 hours
CS grade 10	60 students X 70 hours =	4200 hours
CS grade 11	30 students X 70 hours =	2100 hours
Total computing hours required		6660 hours

Minimum machine requirements

6660 hours / 1000= 7 computers with disk access and printer available.

Year 4

CL grade 9	60 students X 6 hours =	360 hours
CS grade 10	60 students X 70 hours =	4200 hours
CS grade 11	30 students X 70 hours =	2100 hours
CS grade 12	15 students X 70 hours =	1050 hours
Total computing hours required		7710 hours

Minimum machine requirements

7710 hours / 1000= 8 computers with disk access and printer available.

It should be apparent to all that the estimated number of students who will enroll in the courses will determine the number of computers required to implement the program. The numbers suggested above must be tempered with the reality of the local situation. For example, in a school setting where the class size exceeds 25 students, an additional computer may be required. Further, it should be remembered that these suggestions represent minimum standards, and that the long term plan should be towards the acquisition of one computer for every three students enrolled in the largest Computer Science class as recommended by the Computer Science, Interim Edition, A Teacher Information Bulletin (1982) available from Saskatchewan Education.

A WORD OF CAUTION

The procedure outlined above is intended to be applied to Computer Literacy or Computer Science classes only. Where time is available on the computers, a school may extend their use into other areas of the school's learning environment. Where such extension involves the purchase of software,[3] administrators should remember that the rationale for the selection of the Computer Science hardware was not based on criteria which would necessarily be applied to selecting computers for Computer Assisted Learning (CAL). This should raise some questions in

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[3] Software refers to programs written in a computer language to perform a specified task.

terms of the longer term strategy on implementation of computers for instructional purposes. Future demands for CAL may require a hardware different from that acquired for Computer Science. The previously purchased CAL software, running on the computers purchased for Computer Science, may not be able to be installed on new hardware purchased for CAL.

Technical Terms

A REVIEW OF SOME COMPUTER TERMINOLOGY

Anyone attempting to make a decision regarding the type of computer to purchase should attempt to gain an understanding of some of the basic vocabulary associated with the technology. Most articles in the hobby journals assume you have some degree of knowledge of the jargon. In discussions with vendors, it is important to be able to discuss the relative merits and limitations of the various types of computer hardware using the accepted terminology. To assist beginners in this regard, we have attempted to summarize some of the more important terminology and concepts. An understanding of this terminology is an important first step in beginning a search for a computer which will meet your needs.

The following page contains a diagram which displays the relationship between the various components of a basic computer system. Conceptually, a computer system can be thought of as having three components:

1. Input units or devices
2. Central Processing Unit (CPU) with memory
3. Output units or devices.

Following the diagram are some brief comments on each of the components and/or devices. To assist the beginner, a page number has been placed beside each device in the diagram. This page number can be used as an index to find the page which provides the description of the device. The descriptions which are necessarily brief, should provide the reader with a basic understanding of the components.

Technical Terms

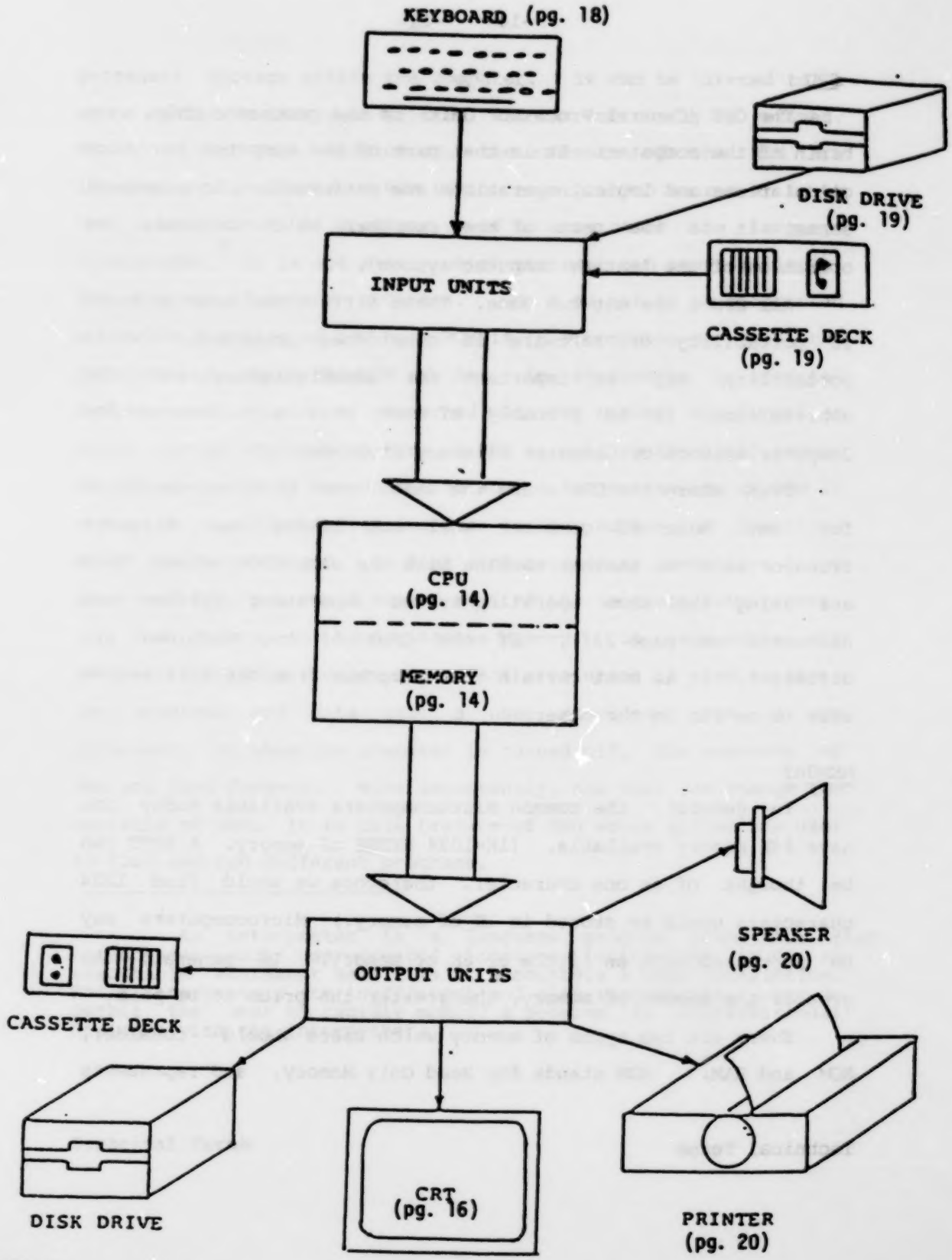
KEYBOARD (pg. 18)
DISK DRIVE (pg. 19)
INPUT UNITS
CASSETTE DECK (pg. 19)
CPU (pg. 14)
MEMORY (pg. 14)
SPEAKER (pg. 20)
OUTPUT UNITS
CASSETTE DECK
DISK DRIVE
CRT (pg. 16)
PRINTER (pg. 20)

FIG. 1

CPU

The CPU (Central Processor Unit) is the processor chip, the brain of the computer. It is that part of the computer in which calculations and logical operations are performed. In a general sense, it is the part of the computer which controls the operation of the "entire computer system".

All CPU's are not the same. These differences must be noted if portability of software is considered important. While portability may be important for administrative and CAL applications, it is probably of much less significance for Computer Science or Computer Literacy Programs.

Even where the CPU's are the same, most programs developed for one make of computer will not likely be directly transportable to another machine with the same CPU unless both are using the same operating system (operating systems are discussed on page 23f). If the CPUs of two machines are different, it is most certain that programs from one will not be able to be run on the other.

MEMORY

In general, the common microcomputers available today can have 64K memory available. (1K=1024 BYTES of memory. A BYTE can be thought of as one character, therefore we would find 1024 characters could be stored in 1K of memory.) Microcomputers may be purchased with as little as 8K of memory. In general, the greater the amount of memory, the greater the price to be paid.

There are two types of memory which users should consider, ROM and RAM. ROM stands for Read Only Memory, and represents

permanent storage within the computer. It can be likened to a stone tablet in that once written, it can not easily be erased. When we turn the machine on, the contents of the ROM are immediately available. ROM is the memory which stores at least the lowest level of programs, and in some cases the language interpreter.[4] It is not memory which the user can have available for storage of data or programs. One need not be as concerned with the question of how much ROM is in a computer as with the question of what the ROM can do. In evaluating a computer system, one should be concerned with the number of functions which can be implemented through ROM as well as the total amount of ROM used. It is reasonable to accept larger amounts of ROM if there is a corresponding increase in the number of functions which can be performed. In most computers where there is a large amount of ROM, you would expect to find the language interpreter.

RAM refers to Random Access Memory. It represents the computer's working storage area, that area which is used to store the programs and data that a user provides. RAM is not permanent, so when the computer is turned off, the contents of RAM are lost forever. More importantly, the user can change the contents of RAM. It is this feature of RAM which allows the user to load and run different programs.

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[4] An interpreter is a language program translator that recondenses each user-created language instruction into an executable statement each time it encounters a user instruction. While interpreters are inefficient and slow translators, they do permit the user to rapidly modify a program in conversational dialogue with the interpreter.

Technical Terms

How much memory is required? The answer to this question lies in what you plan to do. Generally, the more memory, the more expensive your system will be. If the application is Computer Literacy or short CAL activities, 16K may be quite adequate. When reviewing software for purchase, the memory requirements should be reviewed to ensure that the existing computer hardware has enough memory to implement the program.

Often there is a trade off between ROM and RAM. For example, a 16K machine with the BASIC interpreter (the BASIC interpreter can be thought of as just another program which is running in the computer) stored in ROM is probably equivalent to a 32K computer with a BASIC interpreter which must be loaded from disk or cassette. Having the language (BASIC or PILOT) in ROM is only a disadvantage should you wish to implement another language which may require additional RAM. This apparent disadvantage diminishes if the computer in question supports a ROM cartridge, and different languages are available in cartridge format.

Additional RAM is usually added in 4K, 8K, 16K or 32K increments. Prior to selecting a particular machine, the user should know the maximum amount which can be added and how it is added.

SCREEN CONSIDERATIONS

The screen refers to the monitor or TV screen upon which the computer output is displayed. The literature will often refer to it as a CRT (Cathode Ray Tube). The desireable characteristics of the screen to be provided will depend to a great extent upon the

capability of the computer and the requirements of the software applications. If the computer supports color graphics, and you intend to make use of this capability, obviously a color monitor or T.V. will be required. To have a computer with color capability but only attach it to a black and white TV would be like attaching inexpensive speakers to an expensive stereo system.

The screen format describes the physical presentation of information on the monitor. This format is determined by the computer, and can be thought of as the number of rows and columns which can be displayed. For user developed software, this should not pose much of a restriction because screen size considerations can be accommodated in the design of the programs. However, for purchased or translated software, the display format requested must not exceed that which the computer is capable of delivering.

Related to the matter of screen format is the physical presentation of the characters on the screen. This is usually done by having the computer generate a series of dots within a block and thereby define a character or letter. These dots are called pixels, and can be thought of as a light bulb which can be on or off. The quality of the display, both for graphics and print characters, will be determined by the number of these dots which are used to form a letter or graphic symbol. The most common size blocks are 5X7, 7X9, and 8X8 dots.

Technical Terms

KEYBOARDS

The keyboard should be considered as a peripheral to the computer, although most of the computers currently found in schools incorporate the keyboard into the computer console. The amount of human engineering (ie. the effort to make it comfortable for human use) must be considered equally as important as the electronic design. For example, a keyboard which places the period ('.') with the numbers instead of in its usual position will not be as convenient, especially for typing text material.

The two most common types of keyboards to be found are the flat panel or membrane type and the mechanical switch or contact type. The membrane type has no moving parts, and is excellent if used in an environment where liquids or other foreign substances could be spilled upon it. It is pressure sensitive, with keys being identified by labels. It is considered to be a rugged keyboard because it has no moving parts. However, this may be a disadvantage for many applications where it is important for the user to obtain constant feedback about what is happening. The flat membrane provides no tactile feedback which may be a disadvantage for an application such as teaching keyboarding skills. The mechanical keyboard is more susceptible to spills, is more expensive and more likely to wear out, however it does provide tactile feedback to the user, and in an environment where a variety of sense feedback is desireable, it may be the better choice. This may be of particular importance where the development of keyboarding skills is considered an important objective.

Technical Terms

STORAGE DEVICES

Storage devices allow the user to save either programs or information in a form that allows it to be recalled at a later time. Where no storage device is available, the programs or information are lost when the computer is turned off.

There are two major types of storage currently available for microcomputers, cassette tape and diskettes. There are three major differences between these two types of storage involving cost, efficiency and reliability. The cheapest diskette system will cost three to four times as much as a cassette system for the same machine. At the same time however, the speed of operation of the diskette is significantly greater than that of the cassette. If the application involves a lot of loading and saving of programs, a diskette may significantly improve performance and result in fewer computers being required. Diskettes tend to be more reliable than cassettes and again will add considerably to the efficiency of the system if many failures in either the loading or saving of programs are experienced on the cassette system.

In general, there is no compatibility between diskettes from different computer systems. It is not possible to take a diskette from one computer system and merely insert it in the drive of another and have the second computer read the information or programs found on the disk. The exception to this is found with 8 inch floppy diskettes where some compatibility exists. Indeed, with adequate planning, a computer system consisting of different computers could transfer, via 8 inch

floppy disks, programs and information.

SOUND AND VOICE

Sound and voice capability are usually only required for special applications such as one might find in Computer Assisted Learning systems.

PRINTERS

Printers come in all shapes and sizes. There is probably more compatibility among printers than any of the other peripherals associated with computers. When considering printers, the speed of print, the type of print, the number of print fonts (sizes of characters), the paper feed mechanism and the interface (the manner in which the printer is connected to the computer) are all matters to be considered.

Printers usually use an impact or thermal method for transfering the characters to the paper. Probably the best thing to be said about thermal printers is that they are quiet. They require a special paper which is considerably more expensive than regular paper, and are usually available in one size only.

Of the impact printers, the most common is the dot matrix printer, although for letter quality printing daisy wheel printers are most frequently used. When selecting the printer, the user should consider the rate of transfer between the computer and the printer, the speed at which the printer can transfer the characters to the paper, and the different print fonts which can be selected. The speed of printing will be

influenced by each of the above factors as well as whether or not the printer can print bi-directionally, that is in both directions. If networking is being considered, a faster printer may be required to keep pace with the user demands for listings. In general, the greater the capacity of the printer, the greater the cost.

SOFTWARE

Software refers to the programs which can be entered into the computer by the user. The programs may be entered (or loaded into the computer's memory) through the keyboard or from an auxiliary storage device such as a diskette or cassette. It is the software which makes the computer a useful tool, and indeed in applications areas such as CAL and administrative systems, the usefulness of the computer will ultimately depend upon the software selected.

For specific applications, the software may well make the difference between successful use of the machine or no use of the machine. Some models of computers have a very broad selection of software available, others have less. Depending upon the application, you should consider both the magnitude and the apparent quality of the software which is available.

In general, if you are looking at a particular application, and have found the software which meets your needs, you should seriously consider either purchasing the hardware which the software requires, or continue your search for more software which will do your application. The translation of software from one machine to another is difficult at best and often impossible.

Technical Terms

This becomes particularly so if the software in question makes considerable use of graphics.

LANGUAGES

A computer language consists of the words or symbols used by humans to provide instructions to the computer. As with all languages, there are a set of rules which govern its use, but unlike languages used by humans, those rules must be followed in a very exacting fashion. "Syntax error" is a phrase well known by computer users, and represents our failure to meet those exacting expectations of the computer.

In all cases, these symbols or words must be translated by the computer into instructions which it understands. This translation is performed by another program which could be thought of as a language processor. Some languages which are available on smaller computers are BASIC, FORTRAN, COBOL, PASCAL and LOGO. Indeed, many of the languages common to large computers can be found on the smaller computers currently on the market.

The most common language found on microcomputers today is BASIC. Unfortunately, there is no standard BASIC, consequently programs developed for one particular manufacturer will not likely run on a different manufacturer's machine. Worse, programs written in one manufacturer's different release or version of BASIC may not run in the subsequent release or version of BASIC without some modification.

While BASIC will be appropriate for most of the needs associated with Computer Literacy and Computer Assisted Learning,

Computer Science courses require the computer to be able to implement another language. If there is a possibility of expecting a computer to use additional languages, the question of memory capacity, and particularly RAM must be addressed in the selection process.

OPERATING SYSTEM

The relationship among the various operating components of the computer are depicted in Figure 2. These various components can be thought of as a series of overlapping shells between the user and the hardware. Each shell has a particular responsibility or role to play in the operation of the computer system, and indeed when taken together represents a complete system.

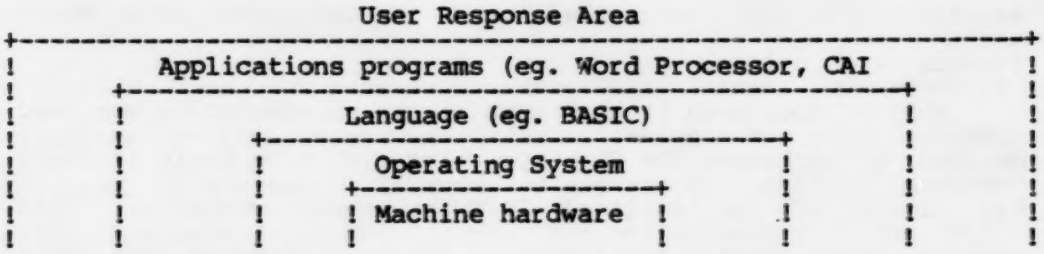

Figure 2

The operating system is the program at the lowest level of the machine. It is the program which allows languages and the applications to make efficient use of particular hardware. It is peculiar to the particular computer upon which it has been installed, and cannot be installed or executed on any other

machine. Frequently, it cannot even be executed on the next version of the hardware issued by the same manufacturer.

There conceivably will never be a standard operating system that will run on all hardware. There is however, a defacto standard for 8 BIT microcomputers which has emerged based on the CP/M 80 operating system.[5] This operating system is based on the 8080/Z80/8058 family of processor chips, and does offer portability of software across that family of small computers which includes over 45 of the microcomputers on the market today.

This does not mean that one can take a copy of the CP/M operating system for one computer and install it on another merely by inserting a diskette into the disk drive and "booting"[6] the system. In general, the format, or manner in which information is stored on a disk is specific to each particular manufacturer's disk controller, and for the most part these formats are unique.

What it does mean is that each of the manufacturers who have decided to implement the CP/M operating system on their hardware has "installed" or "tailored" CP/M for their computer. This usually means that a small machine language program has been

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[5] CP/M 80 refers to 'Control Program, Microcomputer'. It is an operating system developed by Digital Research specifically for microcomputers. It has been implemented on over 45 different microcomputers to date.

[6] Booting the system refers to the procedure used to get the computer ready for operation after it has been turned on. This is usually accomplished by a program contained in the internal operating system ROM.

installed within CP/M by the hardware manufacturer. Typically, this program provides for communication between the operating system and the computer hardware. Like other low level programs, it cannot be transported from one computer to another.

The advantage of CP/M is that applications programs developed to run under CP/M can be transported between machines which run under CP/M. CP/M provides the basic routines for input and output, regardless of device type. These become standard system calls which are handled by CP/M. For example, when a BASIC program wants to print a message to the console device (screen), the message is passed to CP/M for output. Because CP/M knows how to access the particular computer's device handler routines, the message is output as required. From the perspective of the applications programmer, how this is done is of little significance.

CP/M does not provide a common disk format, consequently diskettes written on one manufacturer's disk drive still cannot be read by another. In order to get an applications program which has been developed for the CP/M environment from one disk format to another requires a communications program to provide a linkage between the two computers. The transferred version of the program gets written to disk by the receiving computer system, and from that point on may be executed from that hardware.

One of the major advantages of this defacto standard has been the development of a large amount of good quality software for many applications. Unfortunately, until recently the initial

purchase price of these machines has been above the price range schools have been prepared to pay, and consequently few schools have purchased machines capable of running CP/M 80. The implication of this is that there is not a large number of educational programs available under CP/M.

With the new family of 16 bit machines beginning to show on the market, one can expect somewhat less confusion. There appears to be a strong interest in moving towards fewer operating systems, and the development of operating systems with greater ability to adapt to different environments. Potential buyers here will be well advised to watch for developments in C/PM 86, CP/M 68000, MSDOS[7] and UNIX.[8] There appears to be little doubt that the most meaningful applications software will be developed under these systems, and further that extended capabilities of these systems may well allow detection and automatic adjustment for applications programs developed under one of the other operating systems. For example, several computers currently on the market offer users dual 8/16 bit processors which give users the capability of running both 8 and 16 bit software. As well, at least one of these provides the ability to read either C/PM 86 or

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[7] MSDOS refers to the disk operating system developed by Microsoft for use by the IBM personal computer.

[8] UNIX is an advanced operating system which is expected to be available on 16 bit microcomputers. It is widely touted as a system which could become the standard for the better quality microcomputers.

Technical Terms

MSDOS formatted diskettes. A further example of the ability to read multiple disk formats is the floppy disk controller board developed by one vendor which will allow read/write operations to at least three different diskette formats currently on the market today.

Technical Terms